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THE UNIVERSITY OF ALBERTA
AN INVESTIGATION OF THE INFLUENCE OF VERBAL
CUES ON THE ATTAINMENT OF CONSERVATION

BY



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A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled An Investigation of the Influence of Verbal Cues on the Attainment of Conservation submitted by Joan B. Iftody in partial fulfilment of the requirements for the degree of Master of Education.

ABSTRACT

This study was designed to investigate the part played by mental age and/or questioning techniques in determining a child's developmental level.

Sixty grade one students from the Edmonton Public Schools were tested individually. Each subjected was presented with identical glasses holding identical amounts of liquid. The liquid from one glass was poured into a wider glass, back into the original glass, then into a narrower glass. This was done twice. During one session the subject was asked "Does this glass contain more than, the same as, or less than this glass?" "Why do you think so?" after each transformation. This test was termed a Piagetian test. During the other session the subject was simply asked which one he would choose to drink and why. This test was termed a Preference test.

The testing of two hypotheses produced the following results.

(1) A t-test indicated a significantly greater number of subjects could conserve on the Preference test than on the Piagetian type test.

(2) A significantly greater number of subjects with a mental age of 6 years and over conserved on both tests than those whose mental age was below 6 but the difference was more noticeable on the preference test.

It was concluded that the hypotheses had been supported. This study has implications both for teaching young children and for testing whether the concept of conservation is present.

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CHAPTER I

INTRODUCTION

BACKGROUND AND NEED

Conservation is defined as "the cognition that certain properties (quantity, number, length, etc.) remain invariant (are conserved) in the face of certain transformations (displacing objects or object parts in space, sectioning into pieces, changing shape, etc.) " (Flavell, 1963). The conservation of continuous quantities is the term applied when referring to fluid quantities. A child who has not developed the concept of conservation of continuous quantities usually thinks that when a given quantity of fluids is poured from one container into another container which is taller and narrower or wider and shorter, the quantity increases or decreases with the rise or fall of the level of the fluid.

Much research has centered around conservation of substance and the task of relating conservation to the equilibration theory (Bruner, 1966; Elkind, 1961; Smedslund, 1961; Brison, 1967; Sullivan, 1967; Cote, 1968). According to Piaget, intelligence is a process of adaptation and organization, and organization and adaptation are the functional invariants involved in establishing equilibrium between the organism and the environment; that is, the establishing of a balance between the external surroundings and the state of the organism. The equilibration theory maintains that logical structure is not originally present

in the child's thinking, but it develops as a function of an internal process, equilibration, which is heavily dependent on activity and experience (Piaget, 1950, 1957). The process of equilibration is highly influenced by practice which initiates a process of inner reorganization (Smedslund, 1961a). This process of inner reorganization, that is, moving from instability to stability and thus maintaining equilibrium, affects the development of an operational notion of conservation, namely, that conservation is maintained in the face of certain transformations.

For conservation to occur, Piaget (1962) feels that the child must be able to perform the following operations: multiple classifications, or the ability to categorize objects in more than one class; multiple relationality, or the ability to see more than one connection between objects at the same time; atomism, or the ability to reorganize states, without loss, into elementary units; reversibility, or the ability to recognize that a changed object can be returned to its original state; and seriation, or the ability to recognize the order of succession. These developments he considers to be primarily determined by chronological age and experience. He does not stress the importance of language mechanisms in the development of logical thought.

Bruner, on the other hand, places great importance on adequate linguistic experience. He sees cognitive develop-

ment as a result of linguistic experiences and maintains that an information processing technique forms the basis, through an internalization process, of three information processing systems. At first the child knows his world by the habitual actions he uses when coping with it. Later he begins to use imagery as a form of representation relatively free from action. Gradually language emerges providing the third system of representation. Each of these three modes of representation - enactive, ikonic, and symbolic - has its unique way of representing events. For Bruner, the transition from ikonic to symbolic thought, that is, the movement from the concrete to the language form of representation, is brought about by the use of language as a means of integrating one's experiences.

Bruner has subjected this hypothesis of transgression to careful research. Because he considers the research into the influence of language, that is the words and methods of combining words used and understood by a community, on the responder inadequate, he feels that special emphasis should be placed on this aspect of the influence of language. His own studies indicate the possibility that the child may have a communication problem. He hints of the possibility of the existence of a problem of "verbal semantics" between the adult questioner and the child responder, when one uses the type of tests employed by Piaget, (1964).

Bruner is not alone in his concern that the influence of language on cognitive development has had inadequate consideration. Braine (1962) also questions the adequacy of Piagetian questioning techniques when investigating the processes that Piaget has investigated.

Attempts have been made by other individuals to test another hypothesis, that is, that a variable besides chronological age and language is relevant to the attainment of conservation: the I.Q. variable. Feigenbaum (1963) is one who has expressed this view. If, as Feigenbaum believes, conservation is not the sole product of age but is related to I.Q. or mental age, a child with a high I.Q. (115 plus) may attain the concept of conservation sooner than a child with an average I.Q. (90-110), because of his advanced mental age.

As Piagetian tests are increasingly being used in elementary classrooms to implement curriculum and methodology, the possibility of the developmental level of children being misjudged as preoperational rather than operational should be of concern, since the tendency is increasingly to use operational levels to determine selection of school materials and curriculum.

Problem

The present study is an attempt to determine the part played by mental age and/or questioning techniques in de-

termining a child's developmental level. Specifically it is an attempt to determine whether subjects who are designated nonconservers by the Piagetian type of questioning, will prove to be conservers on a second type of test, (termed a Preference test) where the form of the questioning is not as dependent on vocabulary development, and whether both groups of conservers are significantly advanced in mental age than both groups of nonconservers.

Hypotheses

1. A significantly greater number of subjects will conserve on the preference test than on the Piagetian Type test.
2. A significantly greater number of subjects with a mental age of 6-0 (6 years, 0 months) or over will conserve on the Preference test and on the Piagetian Type Test than subjects with a mental age below 6-0 (6 years, 0 months).

CHAPTER II

REVIEW OF LITERATURE

Elkind (1961) replicated Piaget's studies in an attempt to add further evidence to support Piaget's findings that conservation is primarily determined by chronological age and experience. Using three types of materials (sticks, liquids, beads) and having each subject compare two amounts of material six times, Elkind found that success in comparing quantity develops in three, age-related hierarchically ordered stages.

Goldschmidt (1967) also replicated Piaget's work on conservation. His study included 102 children in the first and second grades in three urban schools: a public school, a private school, and a clinically oriented day school for emotionally disturbed children. He used a variety of continuous quantity transformation tests and his findings clearly categorized the normal subjects in both the public and private schools, with respect to their level of conservation on these tests. The older subjects were consistent in performing on a higher level than the younger children. This finding supports Piaget's theory of age-dependent cognitive development.

Goldschmidt also included a group of emotionally disturbed subjects in his study. The emotionally disturbed subjects were of lower I.Q. and their verbal facility, as measured by the WISC Vocabulary subtest, was inferior to that of the normal subjects. On the average, the disturbed

subjects were chronologically two years older than the normal subjects. If chronological age is the only variable relevant, they should have been superior on the conservation tasks. However, Goldschmidt found that there was no significant difference between the levels of conservation of the two groups. This finding led Goldschmidt to believe that there is a definite correlation between I.Q. and/or verbal facility and conservation attainment.

Goldschmidt's results, however, may have been affected by other variables not mentioned. It is possible that chronological age was the only relevant variable for the normal subjects, however, emotional disturbances may be a significant variable affecting the development of the disturbed subjects. The I.Q. measurement for these subjects may also have been inaccurately assessed.

Overholt (1965) also produced evidence that the I.Q. variable was important in conservation attainment. He used a selected sample of fourth-grade pupils consisting of 172 boys and 157 girls. The Lorge-Thorndike Intelligence Test, form A, was used to measure the intelligence of the subjects. Overholt used two conservation tests. For the first test the subjects were asked to select two balls that were the same size and that contained the same amount of plasticine. The examiner then rolled one of the balls into the shape of plasticine in it now?" (As this is a leading question the results of this study may have been unduely influenced). After

each subject had responded and had given a reason for his response, the plasticine was rolled into a longer "hot dog". A similar question was then asked and the subjects responded in a similar manner. The long "hot dog" was then broken into three pieces and the subject was questioned again to determine whether or not the subject was conserving substance.

The second conservation test involved the same conservation of substance concepts, but the materials used for the test (four soft cotton ropes) involved mass rather than length. Each subject was required to select four ropes that were the same size and contained the same amount of cotton. Then, in successive steps one rope was tied into a knot, one was separated by strands, and one was cut into pieces. After each step the subject was asked whether or not the ropes were the same size and contained the same amount of cotton. Time was given after each response to allow the subject to write the reason for his response. To evaluate the subject's response criteria were established for rating each subject as passing or failing the test. Any subject who failed any item on either of the two conservation of substance tests was classified as a nonconservers. Those subjects who passed on both conservation tests were classified as conservers. Overholt found that conservers achieved significantly higher scores (.01 level of significance) on the Lorge-Thorndike Intelligence Test than did the nonconservers.

Similar results were attained by Beard (1960) when he attempted to "ascertain whether the various kinds of concept development, as described by Piaget, were self-contained, that is, uninfluenced by outside factors such as environment, or whether they corresponded with general intelligence." Beard suggested that if the results corresponded more closely with mental age than chronological age, it would follow that general development depended more on intelligence than age as such. In the same study he also attempted to discover whether the nature of the children's answers showed the presence of all stages despite a limited age range, and whether individual differences were sufficiently great to modify the idea of universal stages in intellectual development.

The sample consisted of 60 children selected from three primary schools in the London area. These included one slum school, one in a moderately prosperous working-class area and one in an area where the children had more mixed back-grounds.

The study included several different tests. One phase consisted of the conception of part and whole or the inclusion of one area within the other. Each subject was shown a drawing of two interlocking circles and was asked to put a farthing inside one and outside the other. They were then asked to place the farthing inside both circles at once. Each subject was then shown a drawing of one circle inside the other circle and was asked to place the

farthing inside both circles.

A second test was based on the child's conception of volume. Each subject was shown two empty glasses, one tall and thin, the other short and broad. They were asked, "Can you show me which glass holds more. You may use the water and glasses if you want to."

A study of correlation between items and the importance of mental age, vocabulary and emotional adjustment showed mean correlations with all items were 0.38, 0.37, and 0.26 respectively. The correlation between items and chronological age was 0.16. The low correlation of chronological age as compared with mental age indicates that the development in concept formation may depend more on increase in mental age than chronological age.

Like Beard, Keasey and Charles (1967) became concerned about the "neglected areas" in studies of conservation. One of these was the area of "natural" experience as opposed to artificial, concentrated experiences, such as those experienced in a laboratory. A second area they felt was neglected in research on concept development was the mental age of the subjects. Their study, therefore, was designed "to investigate whether two groups of children with the same mental ages but with varying amounts of life experiences, as measured by the chronological age, would differ in their understanding of conservation of substance."

(p. 272) The subjects consisted of 21 mentally retarded children from the Woodward (Iowa) State Hospital and School and 21 normal children from Iowa public schools. The two groups were matched according to mental age.

The conservation tests consisted of transforming one of two identical plasticine balls into a sausage, a pancake, and a donut. In each case the subject watched the transformation take place. After the transformation the subject was asked, "Now do both of these have the same amount of clay: that is, is there as much clay in this one as there is in this one?"

The results of the study showed that even though the retarded children had had more life experience, their responses did not show greater understanding of the concept of conservation of substance.

A second aspect of this study concerned the role played by mental age in concept development. They found that "increasing mental age correlated 0.70 with the number of yes responses" (that as a positive response to the question - is there as much clay in this one as this one?). Increasing mental age correlated 0.63 with the number of symbolic responses to the question, (that is, all explanations which directly or indirectly referred to previous events in the same test item such as, "You did not take

anything away.") and 0.64 with the number of perceptual responses (that is, all explanations that directly or indirectly referred to observable features of the situation such as "It is bigger").

All of these correlations were significant beyond the .01 level. Thus, understanding the concept of conservation of substance correlated very highly with the mental age of the subjects. Keasey and Charles concluded, therefore, that the chronological age of a subject is not the only factor in his concept development. The intellectual abilities of a child must also be taken into consideration. Mental age, they felt, is an important factor in the development of conservation of substance.

Similarly, Mannix (1960) found a high correlation between mental age and conservation. He used a small group of children with mental ages from 5 to 11, and used Guttman's technique of scalogram analysis. He obtained a correlation of 0.61 between mental age and the scaled test responses and a correlation of 0.52 between chronological age and the scaled test responses. Mannix claimed that evidence regarding the relationship between performance of Piagetian tasks with mental ability as measured on his tests indicated that to some extent brightness pays off.

Almy et al (1966) were also concerned about the relationship between the ability to conserve and the abilities measured in the traditional tests of mental maturity and

academic achievement. In an attempt to clarify previous findings, Almy selected the subjects from two New York City elementary schools. The population of one school was predominantly middle class. The population of one school was predominantly lower class.

Each child was interviewed separately and "each interview provided each child with seven opportunities to indicate whether or not he was conserving". (p. 62) Task A involved the conservation of the equality of number of two rows of blocks through two transformations. After each transformation, the subject was asked, "What about now?" (Where no response was forthcoming the further question, "Are there more red or more yellow or are they the same?" was asked). The subject was also asked for an explanation.

Task B involved the counting of one set of blocks used in the previous task, followed by two transformations: spreading and rebunching. Task C involved conservation of a continuous quantity when it was poured from a tall tumbler into a shallow bowl. The results of her study show that conservation abilities vary with the task and the age of the child, and there are individual differences. In general, "middle class children who are conserving in all three tasks are mentally more mature than those who are not". (p. 71) The trends for the lower class group were much less clear.

The results of her study also suggest that the child's responses in the interview may be importantly influenced by his beliefs about the adult's expectations for him. Some children apparently saw the interview as a situation where the adult was testing their knowledge but others viewed it as an invitation for fantasy and free association.

As mentioned earlier, other researchers are concerned about the influence another variable might have upon conservation attainment; that is, the influence of vocabulary. One such researcher is Braine (1959) who postulated that language played a greater part in conservation than Piaget indicated and put forward the hypotheses that vocabulary development may well be a factor in many of Piaget's experiments. He postulated that "the confounding effects of language can not be eliminated unless nonverbal methods, (nonverbal as defined by Braine means avoiding the use of words such as 'greater than', 'less than', and 'same as') of presenting the tasks, to the subjects, are used". (p. 6) To test his hypothesis Braine selected 41 subjects ranging in age from 3-6 to 7-0. He presented these subjects with a task consisting of discrimination problems. During the first half of the test the subjects were taught to always choose the shortest (or the longest) upright to attain the reward (candy) hidden underneath. The uprights

were presented in pairs and consisted of wooden pegs with cross bars on the top, ($\uparrow \times$), which were intended to make height discrimination more difficult; however, the subjects were merely told to find the candy. During the second half of the test the subjects continued to choose either the tallest or the shortest upright, according to their previous training. Differentiation of height was more difficult, however, and the subjects had to use a measuring stick to make the discrimination. The results showed that a regular development appeared to occur, and that in this sample fifty percent of the children who made the correct inference, that the reward was always under the longest (shortest) upright, were between the ages of 4-2 and 5-5. This is in contrast with Piaget's results which showed that his subjects did not make a similar inference until between the ages of 7-0 and 7-6. Braine suggests, therefore, that the controlled vocabulary he utilized probably was a major factor contributing to the difference between his results and Piaget's.

Susan Carey's experiment (Bruner, 1966) produced similar results. She devised a trial experiment to examine the connection between compensation and conservation. She used 19 nonconserving four-and five-year-olds as subjects. The experiment consisted of five "tests". A partly filled beaker of water was placed before the child and next to it

an identical beaker, "his glass". (p. 202) He was then shown a series of five pairs of beakers with the instruction to choose the one in each pair that would give just the amount of water necessary for his glass to match the experimenter's glass. The size of the beakers and the water height in the five beakers varied so that only one choice was correct.

Half of the choices of the four-year-olds and half of the choices of the five-year-olds were correct. Although the study lacks careful control, it does suggest a less verbal way of carrying out conservation studies. Of even greater importance, the study indicates that action-oriented procedures produce earlier instances of conservation than that produced by the conventional verbal procedures. In his evaluation of the study, Bruner suggests that there is a problem of "a match between the child's language and his way of organizing the experiences to which the language must be applied". (p. 204) "Same" and "more" do not have the same sensus (semantic markers) as they do in adult speech and are not being fitted to the adult selection requirements demanded by the conventional verbal procedures. (p. 204)

"The source of difficulty comes not exclusively from the slow pace of learning to match semantic markers to selection requirements. It comes also from the fact that the child does not have the structure built for dealing with perceived identity in a way appropriate for using language in a complicated way." (p. 205)

In another study, Mary Potter (Bruner, 1966) produced results that tend to raise the same doubts about linguistic abilities. Potter attempted to investigate the problem of perceptual recognition; that is the ability to make a connection between a present experience and the memory of a like experience. She felt that a child of six is unconcerned about the relation between the information now available and the information encountered earlier. Thus, she suggests that "in a recognition task the young child will stay close to the stimulus with a minimum of interpretation and with little attempt to attain logical coherence in his ideas". (p. 104) The older child should go beyond the simple responses and move towards the elaboration of their hypotheses.

In an attempt to prove her hypothesis she used six series of familiar photographs which she showed to subjects ranging in age from 3 to 22. Each set was composed of from 12 to 14 pictures of the same object in varying focus, from very blurred to clear. As each subject viewed each stage, he was required to tell what he thought the picture was. All responses were tape recorded and analysed upon completion of the testings.

The results of her study show that the "span of integration" increases with age. The ability to integrate two dependent variables in recognition - the visual stimulus

and the memory store - continues to grow, perhaps reaching a culmination only in adulthood. Thus, Potter questions, is there any inkling of whether the child's perceptual experience is organized in a fashion to permit its ready translation into linguistic form? Is the young child's insensitivity to perceptual incongruity related in any way to his weakness in being able to see incongruity in speech samples?

Such verbal confusion became evident in a study carried out by Lovell and Ogilvie (1960). They became concerned about the lack of controls used by Piaget and attempted to "trace the development of the concept: invariance of substance under more controlled conditions". Their subjects consisted of boys and girls enrolled in a junior school in England. Each subject was presented with six balls of plasticine, only two of which were of equal size. Equality of the two had to be established before the experiment continued. The experimenter then rolled the subjects ball into a sausage and the subject was asked, "Who has the most plasticine now? Why do you think so?" (As this is a leading question, the results of the study may have been unduely influenced). For clearly nonconserving subjects an attempt was made to force the subject to consider two dimensions simultaneously and to see what changes in thought occur, if any. Their results showed considerable verbal confusion in the first two years of the junior

school. The subjects confused such terms as longer, fatter, shorter, bigger, thicker, smaller. This necessitated reading into the child's responses what the experimenter thought the subject meant. Therefore, this confusion being prevalent in the child's remarks, we can not be sure that either Piaget or other researchers judge correctly whether a child is a conserver or a nonconserver.

Elkind (1961) came to similar conclusions about verbal influence after repeating a number of Piaget's experiments related to the conservation of quantity. One study included 80 subjects ranging in age from 4 through 7. He found that success in comparing quantities increases significantly with age. He also found there was a correlation of 0.43 between conservation and I.Q. The correlation between conservation and verbal performance was 0.47. These correlations, he felt, supported Bruner's ideas.

CHAPTER III

DESIGN OF THE STUDY

SAMPLE

The sample consisted of sixty grade one boys and girls enrolled in the Edmonton Public Schools. The subjects had a chronological age of 7-0 and below, and came from middle class families. For the purposes of this study middle class family is defined as a family with an income between \$5,000 and \$15,000. Income was established by determining the father's occupation as recorded in the child's cumulative record, and by finding the average income for that occupation. The average income was determined by referring to Blishen's Occupational Class Scale. (Blishen, 1961)

Using Kupfer's Edmonton Study on community opportunity assessment, two schools where the mean family income for that census tract was between \$5,000 and \$15,000, were selected. From these two schools the sample for the study was drawn. All the grade one students in these schools were tested by means of the Detroit Beginners Intelligence Test form A, and 60 subjects were randomly selected from this group of children. Thirty subjects were selected from the mental age category below 6 years, and thirty were selected from the mental age category 6-0 and above.

This study was designed to investigate conservation trends, therefore, it was felt that 30 subjects in each mental age category was sufficient.

All subjects selected were questioned to check their understanding of the terms 'more', 'less', and 'same as'. This understanding was ascertained by having the subject examine a container of liquid from which he poured into a second container a smaller amount, an equal amount, and a greater amount. If the child did not understand the terms, he was not included in the sample. Subjects who were dropped for this reason were replaced in the same manner as the original subjects. The descriptive data for the sample is found in Table 1.

A t-test of significance was applied to the data to determine whether the difference between the means in mental age for the two groups was statistically significant. This data is found in Table II. The mean difference between the two groups was significant at less than the .05 level.

TABLE I
DESCRIPTION OF THE SAMPLE

M.A. Group	Number	Chronological Age* \bar{X} Range	Mental Age* \bar{X} Range
Below 6-0	30	71 60-86	69 57-71
6-0 and above	30	75 69-81	90 72-110

* C A and M A are expressed in months

TABLE II

STATISTICAL COMPARISON OF MENTAL AGE MEANS
OF SUBJECTS IN BOTH TESTS

M.A. Group	Piagetian Test				Preference Test							
	Mean	S.D.	$\frac{\text{Variance}}{\text{**diff. prob.}}$	$\frac{\text{Means}}{\text{diff. prob.}}$	Mean	S.D.	$\frac{\text{Variance}}{\text{diff. prob.}}$	$\frac{\text{Means}}{\text{diff. prob.}}$				
below 6.0	0.567	1.023	.529	.601	3.034	.005	0.900	1.136	0.140	.890	3.942	1.00*
6.0 and over	1.267	1.123	-.529	-.601	-3.034	-.005	1.900	1.165	0.140	.890	3.942	1.00*

* significant - less than the .05 level

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**diff. = difference
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** prob. = probability
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The Tests

The experiment consisted of two tests. The first test was a Piagetian Type test. A description of this test is included in appendix A. Each subject was asked, "Does this glass contain more than, the same as, or less than this glass?" "Why do you think so?" after each transformation. The second test was a Preference test; that is, a test where the child simply makes a choice as to which of two amounts of a soft drink (Kool aid) he prefers. Kool aid is a drink which most children like and because he is not being asked to make a judgement which is based on adult vocabulary (is there more than, less than, etc.) it is hypothesized that this task will be less confusing to the child than the Piagetian tasks with its more adult vocabulary. Therefore, it is hypothesized the child's acquisition of conservation will be more adequately assessed with the preference test. The Preference test is described in appendix B.

Procedure

All subjects were individually administered the Piagetian test and the Preference test. Both tests were administered during the same testing session. The order in which the tests were administered was randomly determined. The tests were given in separate rooms.

Analysis

All responses to both tests were recorded verbatim. Subjects were categorized in the following way. If all the questions were correctly answered, he was classified a conserver. If he conserved sometimes but was not consistent or if he contradicted himself, he was considered to be a transitional stage between conserver and nonconserver. For the purpose of this study these subjects will be termed partial conserver. If he did not conserve at any time, he was classified a nonconserver. These criteria were applied to the protocols for both tests. The number of conservers, partial conservers and nonconservers were determined in this way. This was carried out for the Piagetian test and the Preference test. This data is summarized in Appendix C. The data were then analysed to determine the number of subjects in each of these categories for each of the two mental age groups: those whose mental age is below 6-0 and those whose mental age is 6-0 and above. A t-test was applied to this data to determine whether the differences were statistically significant. The level of significance which was accepted as significant was the .05 level. A Pearson Correlation was also applied to the subject's performance on the two tests to determine the similarity of performance on both tests (Table V).

CHAPTER IV

RESULTS

On both tests, the Preference Test and the Piagetian Test, the number of conservers, partial conservers and non-conservers was determined. These results are found in Table III.

In the below 6-0 mental age group there were 4 conservers in the Piagetian Type test as compared to 7 conservers in the Preference test; there were 6 and 14 partial conservers and 20 and 9 nonconservers on both tests respectively. In the above 6-0 mental age group there were 6 conservers in the Piagetian Type test as compared to 13 conservers on the Preference test; there were 9 and 11 partial conservers and 15 and 6 nonconservers on both tests respectively.

A t-test of significance was also applied to the data. This information is summarized in Table IV. The differences between the groups were significant for both mental age levels at the .05 level.

The subjects' performance on the two tests was correlated to determine the similarity of performance on both tests (Table V). A Pearson Correlation of .33 was found. This is a fairly low correlation although it is significant at the .01 level. The low correlation would seem to indicate that perhaps the two tests are measuring different

abilities. However the examination of a linear graph of the results indicated that a large number of the subjects obtained zero (that is, they were nonconservers) on the Piagetian Type Test. Of the 60 subjects, 36 obtained a score of zero on the Piagetian Type test compared to 15 who obtained zero on the Preference test. This would tend to lower considerably the correlation of Performance on the two tests.

TABLE III

NUMBER OF SUBJECTS BY MENTAL AGE WHO CONSERVED ON BOTH TESTS

M. A. Group	N	Piagetian Type Test			Preference Test		
		Conserver	Partial Conserver	Non Conserver	Conserver	Partial Conserver	Non Conserver
Below 6.0	30	4	6	20	7	14	9
6.0 and above	30	6	9	15	13	11	6

TABLE IV
SUBJECT'S PERFORMANCE ON BOTH TESTS, BY MENTAL AGE

M. A. Group	N	Piagetian Test		Preference Test		Variance between the two groups		Means of the two groups	
		Mean	S.D.	Mean	S.D.	diff. prob.	diff. prob.	diff. Prob.	
below 6.0	30	0.57	1.02	0.90	1.14	1.05	0.57	-1.17	0.24*
6.0 and above	30	1.27	1.12	1.90	1.16	1.26	0.84	-2.10	0.04*

*Significant at the .05 level

TABLE V

CORRELATION OF PERFORMANCE ON THE PIAGETIAN TYPE TEST AND THE PREFERENCE TEST

Type of Test	Mean	S.D.	Correlation	Probability
Piagetian	0.733	1.102	0.33	0.009*
Preference	1.583	1.197	0.33	0.009

*Significant at the .01 level

CHAPTER V

CONCLUSIONS

SUMMARY

Recent research indicates that students classified as nonconservers by the traditional Piagetian Type of testing may be so classified because of a communication problem in the testing situation rather than an accurate assessment of developmental level. A young subject faced with the necessity of stating whether one amount is "larger than", "smaller than" or "the same as" another amount is faced with a vocabulary he may or may not understand. Furthermore, recent literature indicates that this communication problem may be more severe for children with a lower I.Q. (below 110) than for those with a higher I.Q. (110 plus).

The present study hypothesized that a greater number of students could conserve on a controlled vocabulary test, designated a Preference test, than on the conventional Piagetian Type test. A second hypotheses stated that a greater number of subjects with a mental age of 6-0 and over could conserve on both tests than those with a mental age below 6-0.

Sixty grade one students from the Edmonton Public Schools were tested individually. Each subject was pre-

sented with identical glasses holding identical amounts of liquid. The liquid from one glass was poured into a wider glass, back into the original glass, then into a narrower glass. This was done twice. During one session the subject was asked, "Does this glass contain more than the same as, or less than this glass?" "Why do you think so?" after each transformation. During the other session the subject was asked which one he would choose to drink and why.

All answers were recorded verbatim and each subject was classified as a conserver, a partial conserver or a nonconserver on each test. The number in each group, for each test, was tabulated. A t -test indicated a significantly greater number of subjects could conserve on the Preference test than on the Piagetian Type test. Also a significantly greater number of subjects with a mental age of 6-0 and over conserved on both tests than those whose mental age was below 6-0 but the difference was more notable on the Preference test.

Conclusions

Two hypothesis were proposed. The first, that the Preference test is a more sensitive measure of conservation than the Piagetian test, was partially supported. There were more children who could conserve with the Preference Test than with the Piagetian test. This was true for both mental age groups. However, the low correlation

between the two tests indicates that perhaps the tests are measuring different abilities. Since the Preference test used a controlled vocabulary, that is, the omission of such words as "greater than", "same as", "less than", it would appear that many of the subjects were confused by this vocabulary when it was used in the Piagetian Type test. This hypothesis was further supported by the amount of subject hesitation noted by the examiner when administering the Piagetian Type test. In the Preference test much less hesitation was noted on the part of the subjects.

The linear graph indicates that the Preference test was able to spread out the subjects considerably more than the Piagetian Type test (that is the subjects were not "bunched" around the nonconserving or zero point; instead, many more were found in partial or transitional stages). This could indicate that the Preference test is a more sensitive test of conservation than the Piagetian Type test. This would indicate that many subjects are actually conserving but that the Piagetian Type test does not indicate this.

Support was also given to the second hypothesis: that children with higher mental ages will conserve earlier than children with lower mental ages. In both tests there were more conservers in the mental age range above 6 years than in the mental age range below 6 years; however, the differences were greater when the Preference test was ad-

ministered. This would tend to indicate that teachers should be aware of the developmental level of each student and establish a program accordingly. Teachers should also be alert to possible communication problems between herself and the pupil.

Recommendations

Before any conclusions can be made about the influence of vocabulary on performance in conservation tasks, much more careful research must be done in this area. On any future tests that are done the tester may be well advised to do a factor analysis of the two types of tests to determine what is being tested. An attempt should also be made to devise a better preference test in order to be more positive of testing the same concepts.

If the results of this small sample prove to be correct, then classroom teachers should be encouraged to suspect results from one source only. It is very likely that various students may be confused by variables such as vocabulary; therefore, results should be checked by another method wherever possible.

As children seem to be able to learn concepts only when they have attained a certain stage of maturity, teachers would be wasting their time trying to teach these concepts to children who have not reached this maturity. By

teaching at the developmental level of the pupils, both student and teacher frustration and confusion could be avoided. Such repeated frustration and confusion could cause a pupil to feel constantly defeated which, in turn, could lead to other emotional problems, such as withdrawal.

Piaget says that conservation develops as a result of maturity, social transmission, environmental experience and equilibration. Unfortunately, the school tends to put emphasis on only one of these criteria, experience, and here the tendency is to be content with inadequate experience such as a verbalization of partially learned concepts and/or rote memorization.

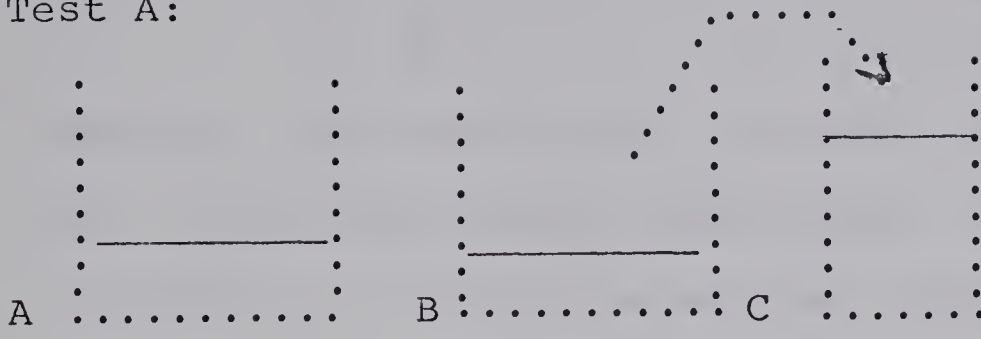
The subjects in this study were not tested until the end of October; therefore, many of them had already been exposed to experiences involving conservation, in their classrooms; that is, experiences involving addition, subtraction, measurement, etc. In view of the number of children who were nonconservers or partial conservers, it is doubtful how much of the instruction in these concepts per se, would be successful. The children would perhaps benefit more from basic experiences employing Piaget's four criteria of learning, than from direct teaching of concepts such as measurement. Time spent in teacher training programs to make teachers more aware of individual differences among children, as well as experience in what to do with these differences would be well spent.

In summary, this study investigated the hypotheses that the form of questioning used in Piagetian tests may confuse the child, particularly the younger or duller children. These hypotheses were supported. The results have implications for teaching and for teacher education.

APPENDIX A

PIAGETIAN TYPE TEST

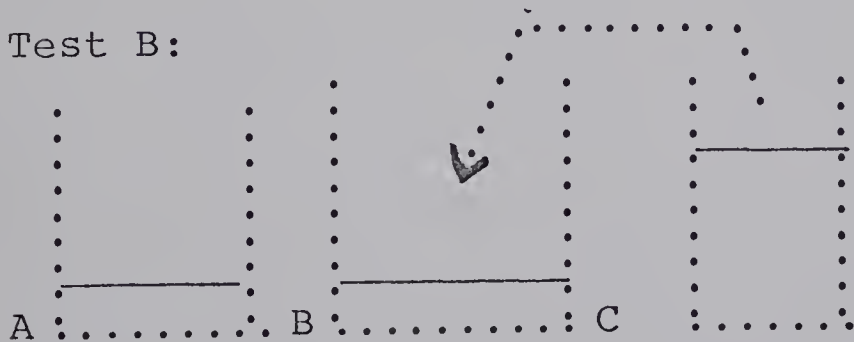
Test A:



The kool aid in container B was poured into container C which was taller and narrower. (Containers A and B were identical and contained the same amount of kool aid).

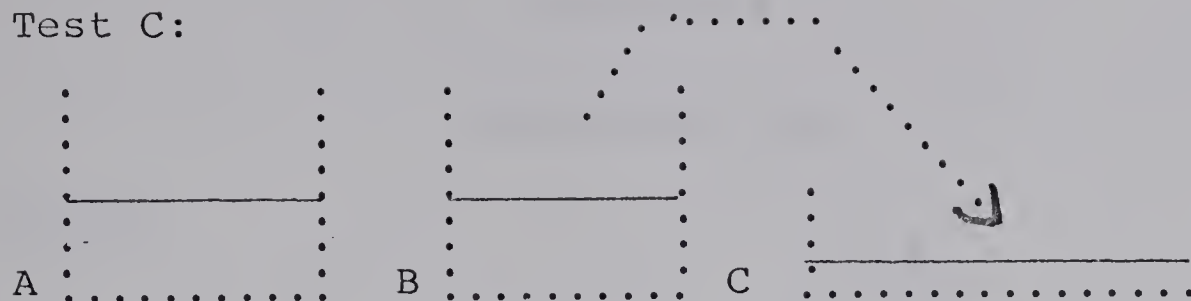
Examiner: I have three containers. Look at them carefully. Watch what I am going to do. (Poured B into C) Does this container (Pointed to C) contain more than, the same as or less than this container (pointed to A)? (Paused for subject's reply). Why do you think so?

Test B:



Examiner: Now watch what I am going to do. (Poured C back into B) Does this container (pointed to B) contain more than, the same or less than this container (pointed to A)? Why do you think so?

Test C:

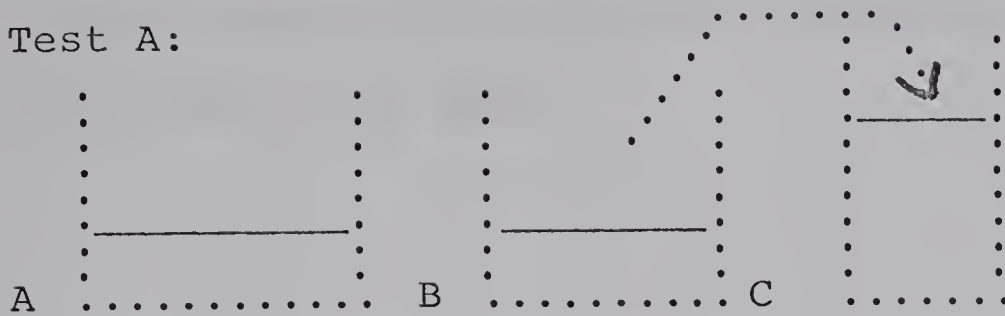


Examiner: Now watch what I am going to do. (B was poured into C which was shorter and wider). Does this container (pointed to C) contain more than, the same as or less than this container (pointed to A)? Why do you think so?

APPENDIX B

PREFERENCE TEST

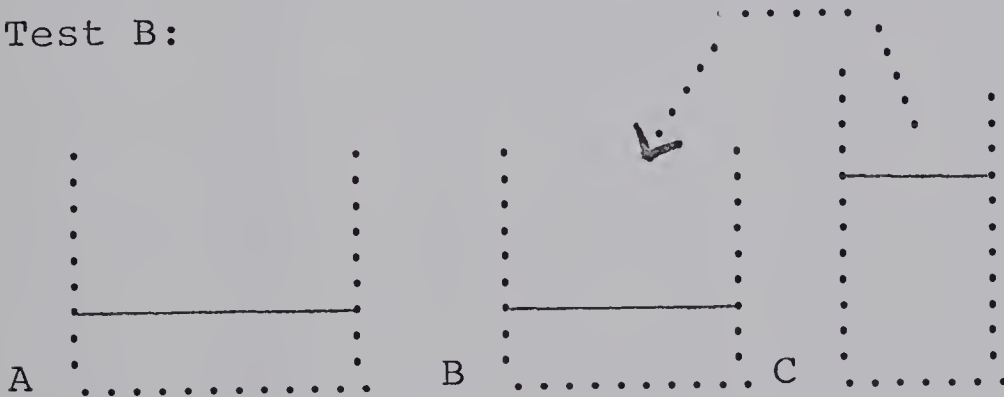
Test A:



Identical beakers containing an equal amount of kool aid was placed before the subject.

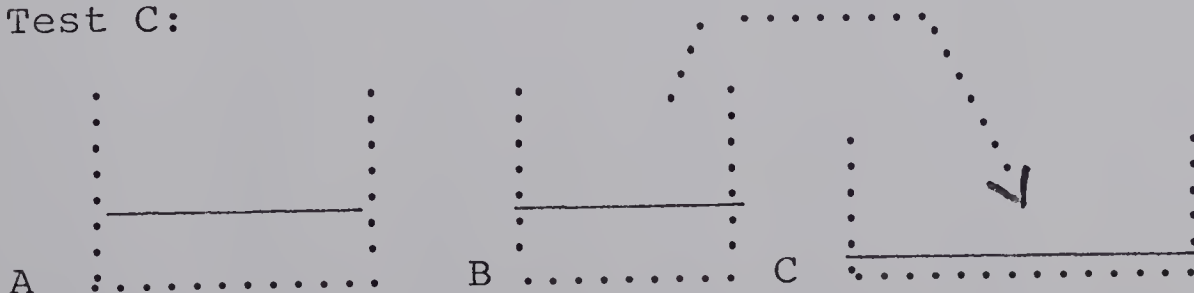
Examiner: Look at these containers carefully. Watch what I am going to do. (Poured B into C.) If you were going to choose one of these to drink which one would you choose? Why would you choose that one?

Test B:



Examiner: Now watch what I am going to do. (Poured C back into B). If you were going to choose one to drink which one would you choose? Why would you choose that one?

Test C:



Examiner: Now watch what I am going to do. (Poured B into C which was shorter and wider). If you were going to choose one to drink which one would you choose? Why would you choose that one?

APPENDIX C

SUBJECTS' PERFORMANCE ON THE TWO TESTS

Child	CA*	MA**	Piagetian Test			Preference		Test
			1	2	3***	1	2	3***
<u>Under 6-0</u>								
1	73	71	N	N	N	N	C	N
2	72	71	N	N	N	N	N	N
3	79	70	N	N	N	N	N	N
4	78	70	C	N	N	N	C	C
5	71	69	N	N	N	N	N	N
6	71	68	N	N	N	N	N	N
7	71	67	N	N	N	C	C	C
8	79	71	N	N	N	C	C	C
9	69	71	N	C	N	N	C	N
10	72	69	N	N	N	C	C	N
11	73	63	N	N	N	N	C	N
12	74	71	N	N	N	N	N	N
13	69	69	N	N	N	N	N	N
14	69	69	C	C	C	C	C	C
15	73	71	N	N	N	N	N	N
16	69	70	C	C	C	C	C	C
17	66	69	N	N	N	N	C	N
18	60	69	C	C	C	N	C	N
19	69	57	N	N	N	C	C	C
20	69	69	N	N	N	N	C	C
21	73	71	N	C	N	C	C	C
22	70	71	N	N	N	N	N	N
23	63	69	N	C	N	N	C	N
24	69	70	N	N	N	N	N	N
25	65	69	C	C	N	N	C	N
26	75	71	N	C	N	C	C	C
27	70	71	C	C	C	C	N	N
28	86	71	N	N	N	N	C	N
29	77	71	N	N	N	N	C	N
30	77	71	N	N	N	N	C	N
<u>6-0 & over</u>								
1	81	79	N	C	N	N	N	N
2	79	90	N	N	N	C	N	C
3	79	103	N	C	N	C	C	C
4	73	92	N	N	N	N	C	N
5	78	84	N	N	N	N	C	C
6	76	96	N	N	N	C	C	C
7	74	110	N	C	N	N	N	N
8	75	91	N	C	N	C	C	C
9	79	86	C	C	C	C	C	C
10	75	102	C	C	C	C	C	C
11	79	87	N	N	N	N	N	N

12	80	78	C	C	C	N	C	C
13	78	87	C	C	C	C	C	N
14	72	92	C	C	C	C	C	C
15	75	80	N	N	N	C	C	C
16	80	102	N	C	N	N	N	N
17	77	101	N	N	N	C	C	N
18	79	81	N	N	N	N	N	N
19	77	105	C	C	C	C	C	C
20	79	83	N	N	N	N	C	N
21	71	85	N	N	N	N	C	C
22	79	97	N	C	N	C	C	C
23	79	95	N	C	N	N	C	N
24	74	94	N	N	N	N	N	N
25	78	100	N	C	N	C	C	N
26	72	89	N	N	N	N	C	N
27	69	94	N	N	N	C	C	C
28	69	80	N	N	N	C	C	C
29	77	79	N	N	N	C	C	C
30	74	72	N	C	N	C	C	C

*CA - chronological age in months

**MA - mental age in months

***1, 2, 3, - number of item in each test

N - nonconserver

C - conserver

SAMPLE ANSWER SHEET

Piagetian Type Test:

Test A: Chose container A _____

B _____

C _____

Reason: _____

Test B: Chose container A _____

B _____

C _____

Reason: _____

Test C: Chose container A _____

B _____

C _____

Reason: _____

Preference Test:

Test A: Chose container A _____

B _____

C _____

Reason: _____

Test B: Chose container A _____

B _____

C _____

Reason: _____

Test C: Chose container A _____

B _____

C _____

Reason: _____

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